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Statements are presented on how quality education can be provided for the individual student within an ever-expaning mass educational system. The ability to provide the best education greatly depends on the means or methods employed, the resources available, and the efficient utilization of both. New methods and techniques can more efficiently optimize the skills of available qualified personnel. The medium of instructional television is gaining acceptance as a primary means for resolving the educational needs of a growing population.

Advantages of television are the ability to project the image and speech of one or more individuals into many separate locations at one time, and the ability to use many sources of audiovisual materials to provide richer and more comprehensive instructional and learning experiences. Objections to television instruction are that it is a one-way communication system, that students do not participate actively or directly in the learning situation, that teachers cannot interact with each student, and that instructors cannot monitor or control the ongoing learning or teaching process. The solution may be in auto-instruction. The term does not refer to devices but to a method of teaching and/or learning which optimizes the ability of an instructor to more efficiently carry on the teaching process.

A concise description of principles of the teletest system and equipment needs are included.

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EXTRACT
FROM

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE
COMMITTEE ON
INTERSTATE AND FOREIGN COMMERCE
HOUSE OF REPRESENTATIVES

EIGHTY-SEVENTH CONGRESS

FIRST SESSION

ON

H.R. 132, H.R. 5099, H.R. 5536, H.R. 5602

BILLS TO AMEND THE COMMUNICATIONS ACT OF 1934 TO ESTABLISH A PROGRAM OF FEDERAL MATCHING GRANTS FOR THE CONSTRUCTION OF TELEVISION FACILITIES TO BE USED FOR EDUCATIONAL PURPOSES

H.R. 645

A BILL TO AMEND THE COMMUNICATIONS ACT OF 1934 TO ASSIST IN THE ESTABLISHMENT AND IMPROVEMENT OF CERTAIN TELEVISION BROADCASTING FACILITIES

H.R. 965 and H.R. 2910

BILLS TO EXPEDITE THE UTILIZATION OF TELEVISION TRANSMISSION FACILITIES IN OUR PUBLIC SCHOOLS AND COLLEGES, AND IN ADULT TRAINING PROGRAMS

S. 205

AN ACT TO EXPEDITE THE UTILIZATION OF TELEVISION TRANSMISSION FACILITIES IN OUR PUBLIC SCHOOLS AND COLLEGES, AND IN ADULT TRAINING PROGRAMS

MARCH 20, 21, 22, 23, MAY 17 AND 18, 1961

Statement of DR. ROBERT E. CORRIGAN

U.S. GOVERNMENT PRINTING OFFICE
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631
INSTRUCTIONAL TECHNOLOGY - U.S.C.

Mr. HARRIS. The next witness is Dr. Robert E. Corrigan, president of the Corrigan Associates, Inc.

I believe you are accompanied by Mr. Love, are you not?

Dr. CORRIGAN. Pardon, sir?

Mr. HEMPHILL (acting chairman). Is Mr. Love with you?

Dr. CORRIGAN. Yes, sir.

Mr. HEMPHILL. Would you like for him to sit at the witness table with you?

Dr. CORRIGAN. Yes, sir.

Mr. HEMPHILL. I might say, Dr. Corrigan, that Mr. Younger wanted very much to be here, but was called to California last night, as you probably know, and Mr. Moss, also from your State, is engaged at another hearing and regrets that he could not be here. However, both of them want to express their appreciation for your coming.

STATEMENT OF DR. ROBERT E. CORRIGAN, PRESIDENT, CORRIGAN ASSOCIATES, INC., GARDEN GROVE, CALIF.; ACCOMPANIED BY C. ROBERT LOVE, VICE PRESIDENT, CORRIGAN ASSOCIATES, INC.

Dr. CORRIGAN. Mr. Chairman and members of the committee, my name is Dr. Robert E. Corrigan, I am a member of the faculty of the University of Southern California and president of Corrigan Associates, Inc., Garden Grove, Calif.

I very much appreciate your invitation to appear before you today. I would like to discuss the important question: How can we provide quality education for the individual student within an ever-expanding mass educational system?

I have submitted a formal statement, Mr. Chairman, and with your permisison, for the sake of brevity and conciseness, I would like to depart from it for the record and touch on the high points of the basic concept to be presented today.

Mr. HEMPHILL. Without objection, your formal statement will be included at this time, and you may proceed as you wish.

(The statement referred to follows:)

STATEMENT BY DR. ROBERT E. CORRIGAN, PRESIDENT, CORRIGAN ASSOCIATES, INC., GARDEN GROVE, CALIF.

Mr. Chairman and members of the committee, my name is Dr. Robert E. Corrigan, I am a member of the faculty of the University of Southern California and president of Corrigan Associates, Inc., Garden Grove, Calif. I very much appreciate your invitation to appear before you today. I would like to discuss the important question: How can we provide quality education for the individual student within an ever-expanding mass educational system? One solution, which is before this committe, is consideration of the role of educational television.

We are naturally concerned with the destiny of our youth—their development, accomplishments and survival. As with ourselves this will depend largely on their receiving the best possible education.

The ability to provide the best or quality education depends greatly on the means or methods employed, the resources available, and efficient utilization of both.

Ours is by necessity a mass educational system. There are few qualified teachers in comparison to numbers of students to be taught. Our present national educational picture indicates that we are in the midst of an explosive expansion in student population. The prediction for this growth is staggering. In contrast, there are fewer and fewer qualified teachers available, with a very bleak future. As an example Dr. Lawrence E. Derthick, U.S. Education Commissioner, indicates we are now faced with a shortage of 195,000 qualified teachers for elementary and high schools alone. Compare this with the States shortage in 1952 of 72,000. The situation has worsened to the degree that the New York State Board of Education estimates that if we are to have enough teachers by 1970 we would require that 50 percent of college graduates between now and then (a period of 10 years) must enter the profession.

Compare this with valid statements that an estimated 43.7 million students entered our schools and colleges last September 1960. The staggering reality is that 52 million can be expected by 1965 (a period of 5 years).

METHODS

It is obvious that the key to the stated problems lies not in personnel resources. It lies in the development of new methods and techniques which can most efficiently optimize the skills of available qualified personnel. But these methods must accomplish other goals. They must provide the best or quality opportunity for each individual to learn and develop. They must further remove for the individual teacher the inherent frustrations, inabilities and sense of failure associated with teaching large groups with conventional instructional methods.

One reality of our educational system is the requirement to establish the group of class as the basic instructional unit. There is nothing wrong in teaching by groups. This has been, and will be for sometime to come a requirement for solving the logistical problems of mass education.

What is wrong, however, is the method or technique conventionally employed for large group instruction (30 or more students).

Conventional group instructional techniques are inefficient for the teacher and for the individual student. This is because of the required roles of each as imposed by the defined method of instruction. The teacher must apply by necessity the lecture method—a one-way communication process from teacher to student. The student by definition plays a passive role. His role is to listen. He is neither required to nor able to respond. The teacher prepares instructional material based on his best "guesstimate" of what is important, the order of importance, and how best it will be understood by the group. There is no provision (rather the capability) for efficient interaction between student and teacher.

If the teacher attempts to "interact" or question individual students only a small minority can be effectively involved in any one class period. The others are "passive"—waiting to be heard and to respond. The question is—"What has each learned?"

The latter statements are not to be interpreted as accusations; rather as realities of established methods of group instruction.

The group for the most part has been the focus in the preparation and presentation of instructional materials. But ours, or any educational system, is not directed primarily toward the learning of groups of individuals. Rather it is to teach each individual within the group.

MASS MEDIA OF COMMUNICATION

Over the years responsible educators have forseen these problems. Progress has been made. Modern methods such as motion picture films, and other audio-visual aids have been developed to increase the efficiency, the problem of group instruction. The most recent is instructional television. Through this medium it is possible for one teacher to reach many classrooms at the same time. This technique can use all audio-visual materials and aids which provide richer learning experience.

Experimental research has established that current television instruction is as effective as conventional classroom instruction. But this medium is an extension of the one-way lecture system, with its inherent problems.

How to solve this paradox. The most promising and efficient solution is the application of autoinstructional principles and associated methods.

AUTOINSTRUCTIONAL CONCEPTS

The concept of "autoinstruction" refers to a method of teaching which is specifically geared to an individual's learning capabilities. It involves the use of new concepts in preparing instructional materials; in new methods of presenting this material; and in the redefinition of the role of the student to assure that each individual has mastered the subject content which he is directed to learn.

This concept embodies a new definition of "communication." Not merely transmission and reception of instructional materials—but comprehension at each step in the learning process.

THE ROLE OF THE STUDENT

Auto or self-instructional methods place equal emphasis on the teacher and the student. They provide the means for each to perform most efficiently—the teacher to instruct in the most direct and constructive manner—the student to learn most efficiently by continual active participation and interaction with the instructor in the teaching-learning process.

The goal of this method is purposive, ordered learning by the individual. The task of the student is different than that for conventional instructional methods. Here the student proceeds step by step in the learning sequence with the requirement that he actively respond at each step; that he be informed of the correctness of his response; and that he makes the correct response before proceeding to the following step.

This method, in essence, assures for student self-accomplishment. The principles of learning involved are based on proven psychological research which indicates: (1) that the individual learns by doing, (2) that he learns better by knowing how he is doing, and (3) that he learns best by first doing; by having immediate knowledge of what he has done; and by being given the correct response before proceeding to further steps in the learning sequence. It is the required self-decision-making activity at each step learning positive knowledge of accomplishment, and continual personal participation and interaction which provides the efficiency for individual learning.

METHODS OF INSTRUCTION

Efficient individual learning depends on the organization, appropriateness, and pacing of the instructional material. Autoinstructional methods require the careful shaping of subject content into its most meaningful sequence—from the most simple to the most complex. Instructional material is presented in small, ordered conceptual "blocks" which build systematically one on the other to insure for student comprehension. The size and shape of these building "blocks" are of a proper conceptual magnitude consistent with the capability of the learner.

The method of teaching is the tutor or coach-pupil technique. This method of instruction provides a 1-to-1 relationship between teacher and student with a continual two-way (back and forth) interaction process.

Applying the tutorial or coach-pupil method of instruction eliminates for the teacher the inefficiencies of conventional group instruction. It accomplishes the following:

(1) Teachers can prepare and present instructional material in the most efficient manner—in carefully ordered, logical steps. The rate of exposure of materials and the size of conceptual steps taken can be controlled—based on expressed student understanding.

(2) Students no longer play a passive role. Each student interacts with the teacher at every step in the teaching-learning process.

(3) Each student is continuously active. At each step he is responding. He makes his responses and is given knowledge of results or "feedback" concerning the correctness of his response. Misconceptions are eliminated. Progressive understanding from step to step is assured.

(4) The teacher is provided feedback concerning the progress of the student. This information can be used to direct the learning of the student consistent

with his performance. It can be used, also, to change the program of instruction to make it more efficient later for other individuals.

(5) It provides two-way interaction between teacher and student.

(6) The end goal—individual learning—is efficiently accomplished.

The comparative merits of the tutor and lecture methods of instruction can be more clearly visualized by presenting the analogy of the use of the fountain of knowledge. In the tutorial method, the student is fed knowledge drop by drop at a rate which he can readily absorb. The lecture situation, on the other hand, applies the firehose technique—lots of force, volume, and coverage. In the latter application we have no direct knowledge of student absorption—or whether he has been drowned. All we do know at the time is that the individual has been completely soaked, for better or for worse.

It is important to note that the basic principles of program construction and presentation are not new. Both the Socratic (tutoring) and Cartesian (logical ordered progression of subject material) have been for ages the basic building blocks of efficient instruction—and still are. But these methods in combination cannot be applied efficiently in conventional group instructional methods.

One thing is certain. We will continue due to necessity to teach in groups. This defines the classroom (30–40 students) as the basic instructional unit.

Another thing is certain. We must attend to the individual student by providing means and methods to insure optimal individual learning.

A recent report by Dr. J. Lloyd Trump, Director, Commission on the Experimental Study of the Utilization of the Staff in the Secondary Schools, presents a number of desirable directions in which we can move toward quality education. Emphasis is on both individual and group learning; on a redefinition of the role of the teacher employing the concept of team teaching; on scheduling problems; on organization of the curriculum; on improvement and utilization of staff, plus others. Above all is the realization of the requirement for carefully considered changes with the end goal being efficient staff utilization and improved student learning.

The distribution and types of instructional requirements for a 30-hour workweek are of significant interest. Based on a 4-year national study it is proposed by Dr. Trump et al., that—

(1) Use large-group instruction for introducing terms and concepts, explaining possible learning activities, planning resources to be used, summarizing materials and evaluating results.

(*a*) Vary the size of large groups with the type of instruction. Make most presentations to groups 80–120 students—using even larger groups to view television or films.

(*b*) Schedule students for large group instruction an average of 12 hours per week.

(2) Use small group discussion for exchanging ideas, clarifying concepts, observing student reactions, and improving personal relationships.

(*a*) Limit the size of small groups to 15 students.

(*b*) Schedule students for small group discussion 6 hours per week.

(3) Schedule students for independent study on an average of 12 hours of the usual 30-hour school week.

The stated recommendations indicate the requirement for group instruction at 60 percent (18 hours) of the average 30-hour workweek; and individual instruction at 40 percent (12 hours of the workweek). The desirability of employing autoinstruction methods for individual study during the assigned 12 hours is indicated. But it is of equal or even greater importance to provide techniques and means to insure quality instruction for groups, and optimal learning for each individual within the group.

What is required is an autoinstructional system which can apply the principles of automated teaching for groups of students but where each student within the group works independently one from the other; where the instructor has complete control of pacing of the group; where each student independently can respond and receive immediate knowledge of results concerning the correctness of his response; and where this autoinstructional system can be extended to tie in with closed- and open-circuit television, and with motion picture films.

INSTRUCTIONAL TELEVISION

The medium of instructional television is gaining acceptance as the primary means for resolving the educational needs of our explosively expanding population.

This growing acceptance of instructional television is founded on two basic premises: (I) the realistic problems of providing a meaningful and efficient educational system for an ever-expanding student population; and, (II) the results of research projects investigating the efficiency of instructional television.

The acceptance of instructional television is based on numerous research projects. These have been either completed or are in progress in numerous qualified educational institutions in the United States. This research has proved that instructional television is as efficient as conventional methods.[1]

As a result of the research, many educators already have seized upon instructional television as the answer to many present and future educational problems.

Some critical objections of conventional instructional television

The primary advantage of existing television is the ability to project the image and speech of one or more individuals into many separate locations at one time. A further distinct advantage for instructional television is the ability to use many sources of audiovisual materials to provide richer and more comprehensive instructional and learning experiences. These capabilities enable a television teacher to address any number of students simutaneously using a broad selection of audiovisual aids.

A most critical and valid objection is raised, however ,concerning the teaching and/or learning efficiency of instructional television. The core of this objection is that television instruction is only a one-way communication system with the inherent disadvantages as previously discussed.

The latter objection is considered to be equally applicable for the individual television student and the television instructor alike.

The specific objection raised in behalf of the television student is his inability to participate actively and directly in the learning situation. This relates not only to his lack of interaction with the teacher but also to the impossibility of presenting questions to which the student gains immediate knowledge of the correctness of his answers. Extensive research has shown the significant contributions of immediate knowledge of results for increasing learning efficiency for the individual student.

Objections raised for the television teacher are his inability to interact with each television student; and, his further inability to monitor and control the ongoing learning and/or teaching process.

These objections are serious and valid.

Programing methods

As stated earlier, the results of research projects with instructional television have shown this method of instruction to be at least as efficient as conventional instructional methods.

Unfortunately, the format for most conventional instructional situations is similar to that conceived for instructional television; namely, the lecture situation. The emphasis in the latter method of teaching is the group versus the individual student. The lecture situation is used primarily because of the previous inability to interact with each student separately.

The optimal instructional television system

A solution to the objections raised by critics of instructional television can be summed up in one requirement: Two-way interaction must be established between the television instructor and each student. Although television instruction must be conceived as one of group participation, it is important that each student in the group perform independently from one another to insure for optimal individual learning.

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[1] Dr. William Allen, report to State Department of Education, Bureau of Audiovisual Instruction, State of California.

Such a capability requires the following operations to resolve the critical objections presented:

(1) Questions or statements must be presented by the television instructor over the conventional transmission system for viewing by television student groups.

(2) Each student must be provided with means to select or construct correct or appropriate answers to questions presented by the television instructor.

(3) Each student must be informed immediately of the correctness of his responses. If his first choice is incorrect he should be allowed to select alternate responses until he obtains the correct answer.

(4) Responses by each student must be recorded immediately and independently in a form which is consistent for each student.

(5) Because of the nature of the television medium as a group instructional system the time allocated for separate questions must be under the control of the television instructor; and the means must be provided the television instructor for advancing from question to question by some system which excludes any possibility of a student modifying answers committed for previous questions.

The stated objections raised by critics of instructional television have been resolved. The solution to the objections are presented in the form of the teletest communications system designed and produced by Corrigan and Associates, Inc., Garden Grove, Calif.

Mr. HEMPHILL. You may proceed; Dr. Corrigan.

Dr. CORRIGAN. Thank you very much, Mr. Chairman.

We are naturally concerned with the destiny of our youth—their development, accomplishments, and survival. As with ourselves, this will depend largely on their receiving the best possible education.

The ability to provide the best or quality education depends greatly on the means or methods employed, the resources available, and the efficient utilization of both. The actual relationship here of the predicted staggering growth in student population versus the number of available teachers for the future, points out that the solution certainly does not lie in the area of personnel resources. So, what we must concern ourselves with are new methods and techniques which can more efficiently optimize the skills of available qualified personnel. The medium of instructional television is gaining acceptance as a primary means for resolving the educational needs of an explosively expanding population.

This growing acceptance of instructional television is founded on two basic premises (1) the realistic problems of providing a meaningful and efficient educational system for an everexpanding student population, and, (2) the results of research projects investigating the efficiency of instructional television.

The acceptance of instructional television is based on numerous research projects. These have been either completed or are in progress in numerous qualified educational institutions in the United States. This research has proved that instructional television is as efficient as conventional methods for classroom instruction.

As a result of the research, many educators already have seized upon instructional television as the answer to many present and future educational problems.

The primary advantage of existing television is the ability to project the image and speech of one or more individuals into many separate locations at one time. A further distinct advantage for instructional television is the ability to use many sources of audiovisual materials to provide richer and more comprehensive instructional and learning experiences. These capabilities enable a television teacher to address any number of students simultaneously, using a broad selection of audiovisual aids.

A most critical and valid objection is raised, however, concerning the teaching and/or learning efficiency of instructional television. The core of this objection is that television instruction is only a one-way communication system. The specific objection is considered to be equally applicable for the individual television student and the television instructor alike.

The specific objection raised in behalf of the television student is his inability to participate actively and directly in the learning situation. This relates not only to his lack of interaction with his television teacher but also to the lack of specific methods to provide the student the ability to gain immediate knowledge of the correctness of his answers for questions presented. Extensive research has shown the significant contribution of providing the capability for immediate knowledge of results for increased learning efficiency for the individual student. Objections raised for the television teacher are his inability to interact with each television student; and, his further inability to monitor and control the ongoing learning and/or teaching process.

In terms of conventional instruction as we know it, that is teaching in groups, because of the number of students to be taught as compared with the availability of teachers, an instructor must primarily use the lecture method of instruction. This requires, by definition, a one-way communication process where students in the group, play a passive role, being neither required to nor able to respond at each individual step in the teaching process. Equally, as well, from the point of view of the teacher, he prepares instructional material based on his best "guesstimate" of what is most appropriate for the group. He must proceed accordingly, without any demonstrative on going evaluation of the quality of his instruction, measured in terms of the comprehension of each individual within the specific learning situation. A solution to this problem appears to be that postulated by exponents of the concept autoinstruction. The term "autoinstruction" does not refer particularly to devices. Rather it refers more specifically to a method of teaching and/or learning which optimizes the ability of an instructor to more efficiently carry on the teaching process and optimize the a new definition of communication—not merely transmission and reception of instructional materials, but required individual comprehension at each step in the learning process.

This method, in essence, assures for student self-accomplishment. The principles of learning involved are based on proven psychological research which indicates (1) that the individual learns by doing; (2) he learns better by knowing how he is doing; and (3) that he learns best by first doing; by having immediate knowledge of what he has done; and by being given the correct response before proceeding to further steps in the learning sequence. It is the required self-decision-making activity at each learning step, the positive knowledge of the correctness of responses, and the continual personal participation and interaction with the teacher which provides the efficiency for individual learning.

Desirably, in place of the lecture format of instruction, which is now logistically required for groups, is the substitution of the Socratic method—the most efficient method of instruction as we know it, the tutorial- or coach-pupil method of instruction. This latter method

would eliminate, for the teacher, the inefficiencies of conventional group instruction. This type of instruction has as its basis the concept of continual teacher-student interaction where questions are posed by the teacher; where individuals have the opportunity of responding and receiving the correct answer; and, where the teacher has immediate knowledge in a group situation of how well he or she is proceeding as measured by student comprehension. This method provides the teacher the ability to deviate in terms of greater or less complex material, or to go over the material to be assured that the students have understood it.

Today we are going to present for your review a system called the teletest communications system. It was designed specifically to answer some of the critical logistical problems for the teacher, where the teacher, in a real sense with this system can be a tutor; and where each student within the group, regardless of numbers of students involved, can be provided the most efficient method of learning by being given the means for an immediate measure or confirmation of his understanding of the particular instructional material. The teletest communication system provides the capability for an instructor on television to teach literally an unlimited number of students. It could be one student, or a million students, where each individual student is provided the capability to gain immediate knowledge of results for answers to questions presented to him over television.

Questions or statements would be presented by the television instructor over the conventional transmission system for viewing by television student groups.

Each student would be provided with means to select or construct correct or appropriate answers to questions presented by the television instructor.

Each student would be informed immediately of the correctness of his responses. If his first choice is incorrect he would be allowed to select alternate responses until he obtains the correct answer, and he would be required to proceed until he achieves the correct response before going on to more complex material. The teletest system provides the classroom or television instructor the opportunity to apply this most efficient method of tutorial instruction for group interaction, with or without television. But for both television and classroom alike there is provided total capability for each student to interact total participation, and also methods for recording each individual student's response for later analysis. The teletest system further allows student response information to be evaluated by the instructor to determine the quality of that instructional content, thereby providing the capability to meaningfully modify the instructional content in order that it may more efficiently reach each individual student in the great television grouping.

I would like to ask at this time that Mr. C. Robert Love, a member of the faculty of Stanford University, and an associate of mine, be permitted to give you a concise description of the principles and the basic equipment of the teletest system on display here today. This is the first production prototype system. These initial teletest systems have been sponsored by the State of California Department of Education. These systems are in the initial research stage in two schools, namely, Anaheim, Calif., and San Jose State College. A third system will be going in shortly at another university.

Mr. HEMPHILL. We would be happy to have his presentation and we apologize that we have no more Members present here. We ran into a parliamentary situation in which we finished up yesterday with the business requiring attendance of most of the Members here. However, that does not lessen our appreciation of your coming here and explaining and identifying this system for us.

Because so many people will only have the written record, if Mr. Love will identify the instrumentation that he is trying to explain, it will be helpful to the people who are not here but who have to depend on the written record to see it.

We are happy to have you.

Mr. LOVE. Thank you very much, Mr. Chairman and members of the committee. What I shall try to do is explain how we achieve what Dr. Corrigan has explained in terms of the teletest communications system.

This device (a flying spot scanner) is one that can be purchased commercially. It simulates a television studio. This is not our equipment but is used for display purposes to provide a simulated closed circuit television capability.

To explain the problem as outlined by Dr. Corrigan, let us assume that I am standing in a television studio and am appearing on camera. This might be a studio on a college campus or a station broadcasting by open circuit throughout the country. For instance, I might be in Chicago and my students might be on the west coast in San Francisco.

The equipment on this table is the studio equipment, and the equipment at the other end of the table is the classroom.

To review the problem, as Dr. Corrigan outlined it previously, I would like you to assume that I am giving an instructional program. As an instructor I want to assure myself that my students are not only watching and listening but are participating with me and, more importantly, are learning something in this exchange. I would like to be able to evaluate each student's individual performance, and, lastly I want to evaluate the effectiveness of my own performance as an instructor.

Let us now assume I have given some instruction in a particular program explaining, in this case, a trouble-shooting procedure in an electric circuit. I have explained to my students how to go through this procedure step by step, and at a specific point in my telecast I want an immediate response, not from a few of the students but from all students. To accomplish this I have prepared for them a question in a multiple-choice format.

In this case let us assume that the correct answer is answer "c". I have instructed my students before the telecast began to insert in the student console on each student's desk an IBM card. This card would have information identifying the course, the student, and other pertinent data. The students have been instructed to respond by pressing the button on their machine that corresponds to the answer that they think is correct. They have been instructed to continue responding until they achieve the correct answer. They will be informed immediately by the machine on their desk whether it is right or wrong.

We have selected the answer "c" in this example as the correct answer. When I push the button marked "c" on my instructor console, a signal is transmitted to the television set in the classroom. This is

accomplished in the following manner. I will now adjust the equipment in order for you to see some black and white spots appear on the television screen. The students would not see these during the telecast.

You will notice, Mr. Chairman, that the light configuration on black and white squares changes when I press different buttons on my machine.

When I press the "c" button on my machine in this case, I transmit this "c" signal to the television set. This information is picked off the picture tube by these photo electric cells and is passed on to each student's machine. Now each machine "knows" that "c" is the right answer. The student's task is to react, make a selection and depress a button. When he sees a red square light appear he knows he is wrong, and when he sees a round green light appear he knows he is right.

All responses made by the student on his machine are recorded on the IBM card, which can then be processed for individual scores indicating how well the student did. But more than this I am able to evaluate how valid my questions were and how I am doing as an instructor.

This device is what we call our spot code generator. It is the piece of equipment responsible for making the spots appear on the television screen. A more precise description of this equipment and how it operates has been included as an addendum to this report.

That, Mr. Chairman and members of the committee, is an encapsulated explanation of how the teletest communications system operates.

Mr. HEMPHILL. Thank you.

Dr. CORRIGAN. If I may insert one concept, it is to state that we are interested primarily in the teaching-learning process. This requires—applying the tutorial method of instruction—the preparation of materials in a new manner in that instructional materials prepared in advance of the class or TV instruction would be broken down into carefully prepared sequential learning steps. Based on this organization of materials, questions are prepared to be presented to students. This in turn would be evaluated later in terms of the group performance (student comprehension).

I wish to impress the fact that this is not saying we are only going to work with groups. It so happens, however, that the problem presented to us in our national educational system is that 60 percent of a student's time would by definition be in group instruction.

One last statement is that in view of cost requirements, size, et cetera, the system has been redesigned to bring it within a more economical range, yet continuing to meet the critical requirements of our educators and the educational system as a whole. This redesign of the teletest system is now being done and the first one of this type will be installed in Central Washington College next month.

Mr. HEMPHILL. Thank you.

Any questions, Mr. Sibal?

Mr. SIBAL. No questions.

Mr. HEMPHILL. I would like to ask the question of how much it will cost to put one of these units on each student's desk, which I assume would be a television classroom initially. How much per desk is the

cost, approximately, for the machines? Also the IBM machine which may be called the answering machine.

Dr. CORRIGAN. The new system as it is designed will cost installed, using the arbitrary number of 30 for a classroom, approximately $2,200 to $2,500, which means approximately $75 per student installed. The television capability requires the purchase of one basic unit which can serve any number of classrooms, 1, 1,000, or 10,000, provided each classroom can pick up the open or closed circuit transmission, in this case. So one spot code generator could serve a broad community and this would cost about $1,200 installed in a transmission site.

Mr. HEMPHILL. Yesterday the Secretary of HEW testified he did not want this in one particular school. He had in mind, too, a regional system of States working in cooperation. If you had a State system in which the central educational facilities of the State were at the broadcasting source and you had 15 or 16 schools—and, like everybody else, I have to think of my own district, my own State—how much would the installation in the broadcasting source station cost and how much would it cost in each of the separate classrooms of 30 students each?

Dr. CORRIGAN. I would say for such a program the minimum cost for the transmission, where the studio is and will be where the program originates from, would be approximately $1,500 and would consist of the spot code generator and the teachers' answer console.

Mr. HEMPHILL. Plus the IBM machine?

Dr. CORRIGAN. No. The IBM machine will be in each of the classrooms. And when, of course, we get into greater quantities—here we are talking in terms of 16 schools and perhaps one classroom in every school—in greater quantities the prices will begin to drop very significantly, in mass production. We would hope in large mass production this would drop to around $55 a student position installed. The IBM installation would not require an IBM card for every student but rather the use of only one card punch machine where one IBM card would be processed for each question prestated by the teacher. On this card, for a specific question, would be recorded the responses of as many as 60 students in any particular classroom.

Mr. HEMPHILL. In connecttion with what Dr. Love said awhile ago about checking on the quality of the teacher or the instruction, as I understand it, the IBM machine flashes back to you the number of right answers and the number of wrong answers, or the percentage, so the instructor can find out whether he is getting the message across?

Dr. CORRIGAN. As presently formed it is feasible to answer immediately back to the instructor in terms of what the group's immediate response was. We are told that in terms of present practices that a TV instructor would desire information concerning the quality of his instruction at a later time. This is because it takes on an average of 20 hours to prepare for one hour of instruction, and because it is so carefully timed there would be no deviation in instruction at the time of actual instruction. The IBM cards would be analyzed for each individual student, and the class as a whole for each individual question following the television program or class period. After a number of hours you could obtain the results of the analysis of the group responses, namely to determine the number of errors that students made for each question, thus providing the instructor a measure of

the quality of his instruction, question by question. If the instruction is most efficient in terms of individual optimum learning there would be only one response, the correct response, for each question. When you start getting a large accumulation of errors for each question, it is at this point the instructor knows he or she is not achieving total comprehension for the students and he or she can go back later and make it more explicit. This is the way it is possible to evaluate the value of the instruction.

Mr. HEMPHILL. I had in mind, I understood you to say in the event students had some question of their own, take 1,500 students throughout a group of high schools, then as I understood you if some question arises in the classroom which the instructor has not specifically covered, through no fault of his own, that would be submitted in a written form back to the instructor to have his staff prepare the answer to go back to the student?

Dr. CORRIGAN. As the questions are proceeding the IBM card recording would give the exact efficiency of that. Following the television instruction, the classroom instructor would continue to carry on the particular instruction, either amplifying it or carrying it on to further materials. If materials have not been covered, then the instructor in the classroom has, of course, the ability of not only sending the IBM material for that patricular group back to the instructor, but can present to the television team the experience he or she has had to expand or make that material more efficient in terms of instruction.

Mr. HEMPHILL. One of the things that has concerned me is the fact that some of the academies to which we appoint various students frequently criticize the student's examination with the words, "lack of scholastic aptitude" or lack of ability to learn. Have you given that concept any thought in connection with educational television? I have discussed that with the heads of two academies, as have other Congressmen and Senators in my presence. That is something we are very much interested in. Two of the factors we are concerned with are the ability to learn and the ability to study.

Dr. CORRIGAN. Actually, this is the central problem for which the Teletest Communications system was designed to resolve. This system provides the most efficient instructional method from the teacher's point of view by assuming that students are actively participating at every step as the instruction proceeds. In the prevailing lecture situation students proceed along without any demonstration of performance for the teacher of how well they are doing. With conventional teaching methods the teacher's only empirical measure of the quality of her instruction is by means of delayed tests. With group instruction, we apply the firehose technique, lots of force, volume and coverage. People are sprayed and are fairly well doused. But we do not know how well they are learning. With the Teletest system we can assume that students are proceeding step by step. Where students are running into a problem expressed in terms of lack of understanding, that problem can be rectified thus assuming that students proceed at a rate consistent with their understanding, and their capability.

Mr. HEMPHILL. You mentioned the fact you use the multiple-choice manner of getting answers. More and more we find examinations for college entrance, academy entrance examinations, and even civil

service examinations are of this multiple-choice method. Has it been your experience that this is the best method of examination?

Dr. CORRIGAN. If I may take a couple moments to expand on this, let me say that the multiple-choice format can be a very valid testing method. But independently of multiple-choice questions—I did not go into this because I did not wish to take too much of the time of the committee—can be a device—an electronic writing tablet—which can be located at each student position. Here I present questions or learning items to the student where the task of the student is to write down or construct an answer prior to being given any information as to the correctness or incorrectness of his written response until after he has committed it. After committing himself by writing down the word or words which he considers to be correct he is provided the correct answer to determine if his answer is right. If he is not right he commits himself to another written response. The teletest system is so designed, however, that the student must be right before he can proceed to a new or more complex question.

The matter of the use of multiple-choice or written responses by the student concerns itself with the ideas of program construction as applied in the field of automated instruction. The teletest system provides for all methods of programing so that all forms of student response can be generated and evaluated in a common method of program analysis.

Mr. HEMPHILL. Mr. Sibal.

Mr. SIBAL. As I understand, this technique is primarily instructional rather than testing?

Dr. CORRIGAN. I conceive it primarily for teaching and learning, but it is directly usable for testing if required in that capacity.

Mr. SIBAL. How would you test other than by the multiple-choice technique?

Dr. CORRIGAN. The multiple-choice technique for testing would be used primarily for group testing. But multiple-choice test questions could be interchanged with write-in questions—with the teletest system to use either type of question, independently or in combination. The capability is there. But, frankly, I have not thought out the uses combining the two.

Mr. SIBAL. In connection with the subject matters adaptable to this multiple-choice instruction technique, what is your experience? How broad a scope can you cover?

Dr. CORRIGAN. To begin with we are talking about the tutorial method of instruction, which by definition proceeds, step by step, leading to the comprehension of some idea, principle, or fact. The tutorial method is the most efficient to reach a defined learning goal. The multiple-choice method can be varied. I can not only ask that you select an alternate choice, but I can proceed to give you the rationale or explanation of why you were right or wrong. When we depart from subject matter with a minimum of logical construction, let us say, history, I can conceive of a method where the student to make the correct response might be required to select two choices, A and C, which together, make the right choice. As an example of such a question, I may list a series of battles and a series of generals and you have to relate the proper two in combination in order to be correct.

Mr. SIBAL. How about a course in algebra? How can you develop the skill for such a course?

Dr. CORRIGAN. I could provide in algebra the most basic method for efficient individual learning by systematically defining the basic operations involved and the suboperations needed to be understood, to apply correctly, the basic principles and the application of these principles. I can break these down into small increments. In the case where the group has not indicated proper understanding of some point, I can vary the instinctional sequence by breaking it down into smaller increments until I am sure I know the students do understand.

I am certain there are certain subjects that are more applicable than others for logical tutorial methods. I would have difficulty teaching basketball with teletest. But other skills can be approached. Let us say in a medical application I have recorded a particular operative procedure. I could then have a staff of physicians or surgeons evaluate the specific subject content, and determine those specifics, thier order and importance, which all surgeons should know for the particular operation in question. I could then insert specific questions into the material that individual surgeons must respond to.

So I can take a one-way communication method such as a conventional motion picture film and make it a true tutorial instrument where you are required to respond at every step and receive immediate confirmation of the correct response. The essence is being forced to reply, having confirmation of results; and being positively active at each step in the teaching process.

Mr. HEMPHILL. We have been furnished with copies of a teletest brochure. That was not made a part of your statement, was it?

Dr. CORRIGAN. No.

Mr. HEMPHILL. Would you have any objection if that were put in the record as a part of your statement, because it has some explanations in here that would answer some of the questions that I am sure will be raised?

Dr. CORRIGAN. I would be very appreciative of that.

Mr. HEMPHILL. We will include this statement headed "Automated Instruction" and consisting of 7 pages.

(The statement referred to follows:)

Teletest

COMMUNICATIONS SYSTEMS

A development by

CORRIGAN & ASSOCIATES

8701 Adah St., Garden Grove, Calif.

AUTOMATED INSTRUCTION

THE NEED

In a press conference in San Francisco on February 21, 1961, Miss Clarice Kline, President of the National Educational Association mentioned some of the urgent problems in the educational field today: "The several thousand children on double shift programs who are crowded out of their rightful quality education, the 32% of high school students who attend schools too small to offer adequate programs, the 400,000 elementary children who go to one-room, one teacher schools for the first eight grades and all this in an era when we are casually launching satellites and firing missiles".

In an exhaustive study of this problem the Educational Facilities Laboratories of New York, a non-profit corporation established to help American schools with their physical problems, in 1960 issued a report urging the planned use of Educational Television to ease some of these logistical problems. Their report points out the following data:

> By 1965 public school enrollment will be over 41 million.
> In 1959-60 there was a teacher shortage of 195,000 teachers.
> There is little likelihood that this shortage will be met.

In terms of physical facilities it has been estimated that we will have to build one classroom every six minutes in the United States for the next ten years to make up for present space deficits and to keep up with the student population explosion.

To quote the EFL report:

> "As of this moment, there are more students to be educated than we can handle effectively by current techniques of teaching and administration. The pressure of sheer numbers promises to get worse, not better, in the years ahead".

WHAT IS AUTOMATED INSTRUCTION AND WHAT CAN IT DO TO EASE THIS SITUATION?

Automated instruction is a teaching/learning technique that involves two entities. (1) Information to be learned is broken down into small steps and arranged in a logical sequence progressing from the very simple to the very complex in such a manner that the learner learns faster and remembers longer. This is commonly referred to as programmed learning and the information ordered in this fashion is called the program. (2) Information to be learned is presented by a mechanical method. The machine used for this is called a "teaching machine". Teaching machines must meet most of the following criteria:[1]

1. They present a small unit of curriculum to an individual student.
2. The student must actively respond (usually by answering a question).
3. The student is immediately informed as to the correctness of his response. (feedback)
4. The student is not permitted to proceed until he correctly responds or at least is informed of the correct response.
5. The curriculum material is very carefully ordered, based on try-outs with similar students.

Thus by proper use of these devices one teacher can instruct large numbers of students and yet maintain the most efficient of all teaching methods, the Socratic method in a true tutorial relationship of 1:1 using a machine simply as an extension of the teacher's capabilities.

According to Stanford Research Institute's Long Range Planning Report for November 1960, of all the recent innovations introduced into the field of education, none affords as great a chance for the improvement of learning techniques as does automated instruction.

WHAT ABOUT EDUCATIONAL TELEVISION, WHAT IS ITS RCLE?

The use of television as an instructional tool does not constitute automated instruction. Like the teaching machine, however, it is capable of extending the teacher's physical capabilities to large numbers of students and over large geographic areas. Television was first introduced in education in 1932 and has been used for formal instruction since 1953. By 1960 half a million students in the country were receiving regular instruction by television. Its growth rate is rapid and there are ample research studies to show that television instruction is at least as good as classroom instruction, and in some respects better. The principal weakness of television instruction is that the student plays a passive role in the learning process. He is not required nor is it possible for him to actively participate in the televised instruction. This weakness is not unique to television but is also prevalent in all large group instructional situations to a greater or lesser degree.

Then why not combine the advantages of television's ability to project instruction to a very large group with the teaching machine's ability to maintain a 1:1 tutorial relationship with the student and teacher?

This is precisely what TELETEST Communications does. Corrigan and Associates developed this systems concept in 1960 to provide a means wherein students learning on television could respond to questions presented on television by the television instructor. In each learning step the student would be informed immediately if he is right or wrong. He would be required to respond until he responded correctly and then he would be permitted to proceed to the next task. To permit careful analysis of both individual and group achievement all responses would be recorded on IBM cards. These cards would also serve as a feed-back method to the teacher.

DOES TELETEST WORK ONLY ON CLOSED CIRCUIT TELEVISION?

No. TELETEST works equally well on either closed circuit or open circuit broadcasting.

CAN TELETEST BE USED ONLY WITH TELEVISION?

TELETEST can be used in any group instructional situation whether it is a large class with one instructor, movies, or television.

HOW DOES TELETEST DIFFER FROM OTHER TEACHING MACHINES?

Most teaching machines require that the "program" must be contained in the machine. The student then by operating the machine is given information, tested, and allowed to proceed at his own rate. Such machines are referred to as "self pacing" machines. Each student proceeds at a rate consistent with his own ability to comprehend.

TELETEST does not require a "built-in program". The teacher presents the "program" when using TELETEST in a method consistent with the material to be presented and with whatever tool are available to make the presentation. The presentation may simply be in lecture form, asking questions verbally or employing the use of a blackboard, charts or other audio-visual devices. With TELETEST, the instructor permits the group to advance together but at the same time each student is given the opportunity to individually react and to receive the correct information before proceeding to the next step.

AREN'T SELF-PACING MACHINES EFFICIENT?

In terms of the learning process there is evidence to show that they are extremely efficient. But remember, in attempting to solve some of the problems facing us in education today, we are faced with a quantitative as well as a qualitative situation. In terms of logistics, that is to say, in saving time in instruction, data processing, program development, and in using existing personnel and facilities to their maximum, individual self-pacing machines are much less efficient than TELETEST. There are very few programs available today for self-pacing machines. TELETEST can be used by any teacher in any classroom right now.

WILL TELETEST REPLACE TEACHERS?

No. TELETEST was designed around the teacher. The teacher is the heart of the system. TELETEST simply is an extension of the teacher making it possible for him to do his job more efficiently. Dr. Frederick W.Dershimer, M.D.*, describes human beings as follows: "They come off the production line, as hammered out by natural forces over millions of years of evolution, ready to go. They are the most complete, automatic, automotive mechanism known. And even if we were capable of designing improved models, we simply could not, in our fourscore years and ten, hope to do so and get the new models into production. We haven't time, even if we had the required knowledge and wisdom . The power plant supplied in the original model is satisfactory in all respects. The energies we designate as natural emotions are fully adequate to drive both the control apparatus we call the mind and through this the rest of the complex servo-mechanism. There is no need to make the machine over".

It was with this concept in mind that TELETEST was developed; to use the teachers we now have to the fullest of their capabilities as teachers and to relieve them of the onerous task of grading great quantities of test papers. Studies show that 30% to 60% of a teacher's routine working day is spent on clerical and housekeeping chores.

BUT HOW DOES TELETEST TAKE INTO ACCOUNT THE SLOW LEARNER AND THE FAST LEARNER?

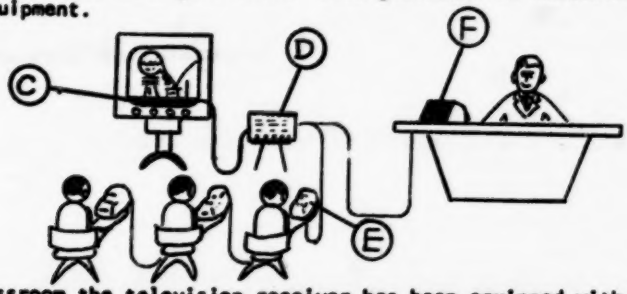
Since all responses, both right and wrong, are recorded on the IBM cards, the teacher can readily (in some cases in a matter of minutes) determine who the fast and slow learners are. They can then be given the individual attention they need. It may be necessary to segment the group into fast learners and slow learners by the same method that we do now. Because of the logistical problems outlined in the first paragraph, it would appear that we will be committed to large group instruction for many years to come.

HOW DOES TELETEST WORK?

To illustrate the operation of the TELETEST system, let us first discuss its application in connection with television. Assume that the teacher is in a

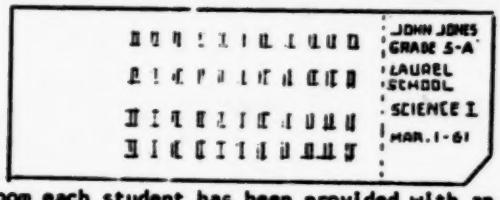
down town studio and is going to broadcast a lesson to all fifth grade science classes in each school throughout the city. Each classroom where the broadcast is to be received is equipped with television and TELETEST equipment. The instructor has prepared his material carefully in small, logical sequential steps. At each step he has prepared questions in the form of multiple choice allowing as many as four choices in each question. At the appropriate moment in the broadcast he will present his questions and require that each student respond to the question and continue to respond until the question has been answered correctly.

In the television station the instructor has prepared his material in advance. In the station with the instructor is (A) a TELETEST instructor/answer console and (B) a TELETEST spot code generator. This generator is installed into the transmitting equipment.



In the classroom the television receiver has been equipped with (C) a TELETEST photo-cell pick-up, connected to (D) a TELETEST power supply which supplies power to each of the (E) TELETEST Record-O-Paks on each student's desk. On the classroom teacher's desk is another instructor/answer console which may be used independently of television.

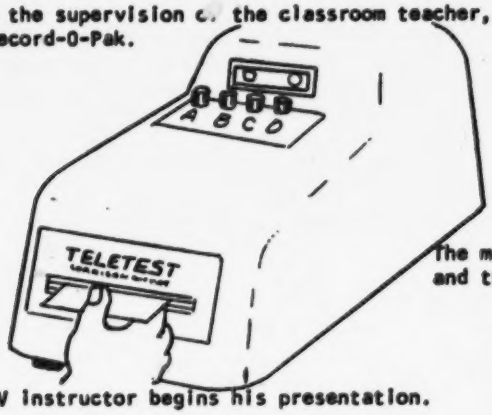
When the broadcast begins, the television instructor tells the students to insert their IBM cards into the Record-O-Pak on their desk.



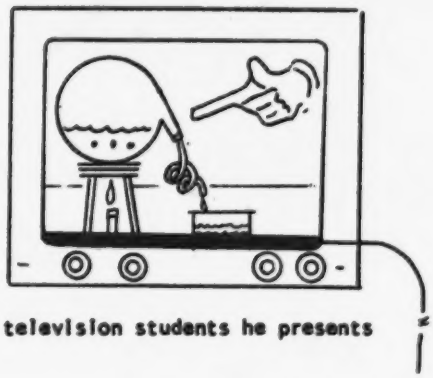
In the classroom each student has been provided with an IBM bearing his name, the class, subject and date.

This card is designed to handle up to 30 questions with room for four responses on each question.

Under the supervision of the classroom teacher, each student inserts his card into his Record-O-Pak.

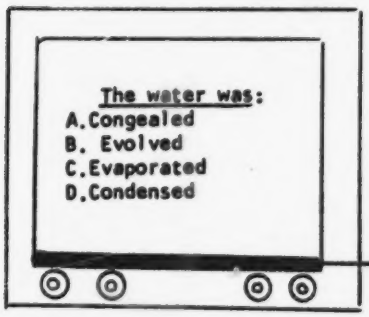


The machine takes the card automatically and the card disappears into the machine.

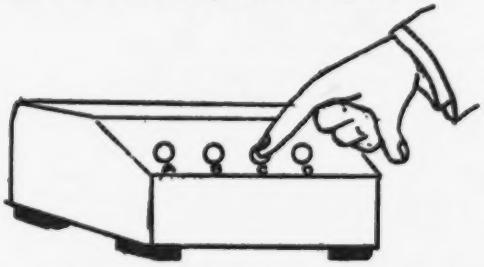


The TV instructor begins his presentation.

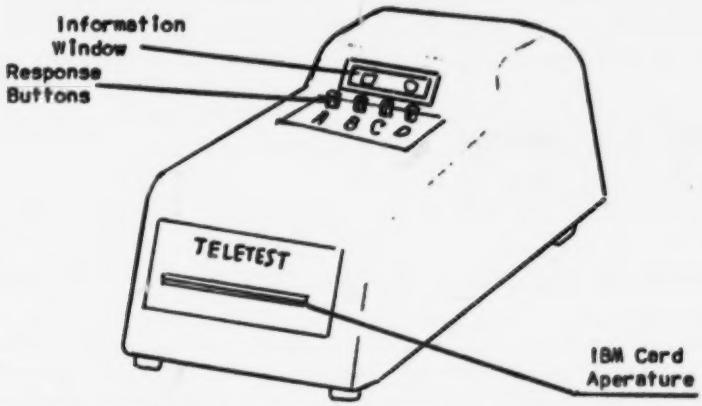
When he's ready to require a response from his television students he presents his question:



In this case, answer "C" EVAPORATED is the response the TV instructor wants. He presses the "C" button on his instructor/answer console which is on the desk before him in the studio, and asks the students to select the answer they think is correct.



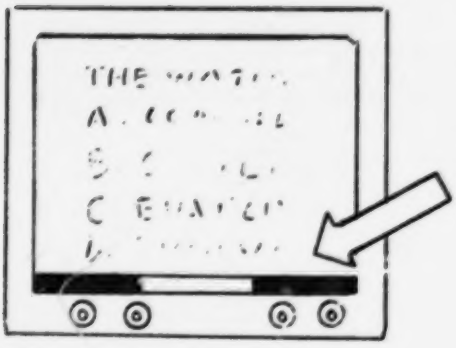
He informs them that if they are wrong, they will see a square red light in the little window on their Record-O-Pak, if they are right, they will see a round green light. They are to continue responding until they see a round green light. (The color blind student will recognize the difference in configuration of the light).



When the television instructor has allowed sufficient time for the student to respond, he advances the IBM cards in each machine simultaneously to the next question. At the completion of the presentation, the cards automatically pop out of the machine where they are collected by the classroom teacher and are ready to be analyzed. In terms of individual scores, a single response for each item would indicate a very high score and conversely, four responses to each qeustion would indicate a very low score. Other data are also readily available. If a very large number of students score four responses on a single item, it might suggest that the instructor should enlarge on that bit of information since it was not clearly understood by a large segment of his television class.

HOW DOES THE INSTRUCTOR IN THE TELEVISION STUDIO CONTROL THE MACHINES IN THE CLASSROOM? DOESN'T THIS REQUIRE A WIRE CONNECTION BETWEEN THE TWO?

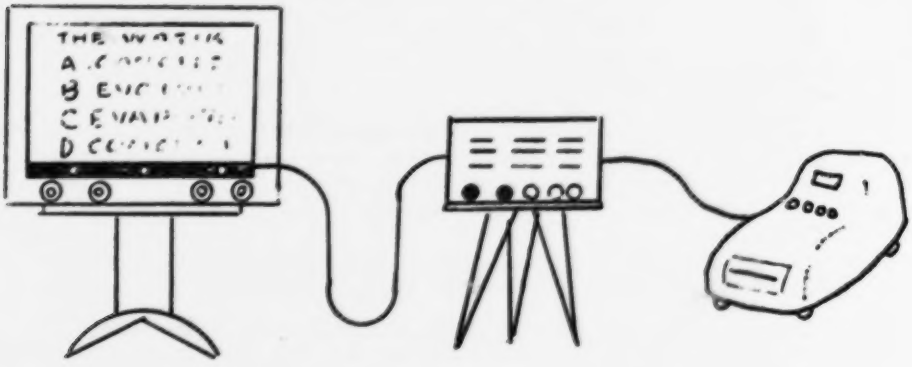
No, there is no wire connection required. When the instructor in the studio presses the "C" button in the example described earlier, he transmits a "C" signal from his answer console to the video spot generator which is an integral part of the television station's broadcasting equipment. This "C" signal is then broadcast through the air simultaneously with the TV picture. The signal is received at the school through the receiving antenna and appears on the picture tube of the TV receiving set in the classroom. This "C" signal appears at the very bottom of the TV picture in the form of black and white spots.



For example, here we see the TV picture. At the bottom of the picture appears a pattern of spots; black,white and black. This pattern indicates that "C" is the right answer.

WON'T THE STUDENTS IN THE CLASSROOM SEE THIS SIGNAL?

No. This small portion of the screen is covered by a masking tape that contains three photo-electric cells. These cells are connected to a TELETEST power supply which transmits the "C" signal to each student's Record-O-Pak and furnishes the power to actuate each machine.



Mr. HEMPHILL. We thank you for your appearance and for taking the trouble to bring all this equipment here. I assure you your testimony has been instructive and it has a marvelous appeal in the educational field.

The reason I asked about the multiple-choice technique, I want to follow it up and ask what has been your experience with this sort of installation in either facilitating what you call the efficiency of instruction or the quality of instruction? What has been your experience?

Dr. CORRIGAN. That basic research literature independent of this system—that is, the actual research substantiating the principles of automated instruction—has indicated that quality of instruction is inherent in the quality of the program material. Quality of instruction and efficiency of instruction as measured in terms of learning by the individual student, go hand in hand. A very poor program will obviously result in poor learning. A program is good when during and following the instructional period the students not only show by their performance progressive understanding, but also that they can perform, following a specific series of instruction, the specific behavior or performance capability the instruction was designed to achieve. I would say literature over the past 25 years shows the combining of autoinstructional principles to be the most efficient method for optimum individual learning.

Mr. HEMPHILL. Then would you say it has been your experience that high school students instructed in this manner are better prepared for college, for instance?

Mr. CORRIGAN. Yes, and more than that. They learn in a significantly reduced period of time because they have been provided a more efficient method of instruction. It is designed to accomplish a very specific goal and it provides the ability to reach that goal in a more systematic manner. A major importance of the teletest system is that it allows the instructor to be the programer and the programer has the ability to apply the most efficient methods of instruction—the tutorial or "coach-pupil" method. In group instruction today this is impossible because of the logistics of the situation.

Mr. HEMPHILL. I want to thank you both for coming here and I am sorry we did not have more members of the committee here to hear your testimony.

Dr. CORRIGAN. Thank you very much.

Mr. HEMPHILL. The subcommittee will stand at recess until further call of the subcommittee chairman.

(The following information was submitted for the record:)

HOUSE OF REPRESENTATIVES,
Washington, D.C., March 24, 1961.

Hon. MORGAN M. MOULDER,
Chairman, Subcommittee on Communications and Power, House Committee on Interstate and Foreign Commerce, Washington, D.C.

DEAR COLLEAGUE: Enclosed is a copy of a letter which I received from the Twin City Area Educational Television Corp., setting forth the views of their organization in regard to proposals for aid to educational television.

I would appreciate your making the attached communication part of the hearings record of your subcommittee's consideration of H.R. 132, and related bills, to provide grants for educational television broadcast facilities.

Thank you for your kind cooperation.

Sincerely yours,

ANCHER NELSEN, *Member of Congress.*